Morris Creek, Charles City County Total Maximum Daily Load (TMDL) For Bacteria Contamination Impaired for Recreational Use

DRAFT DOCUMENT

Virginia Department of Environmental Quality

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Executive Summary

This document details the development of a bacterial Total Maximum Daily Load (TMDL) for Morris Creek in Charles City County, Virginia. Morris Creek (G08R-01-BAC) was listed as threatened for primary contact (recreation or swimming) use on Virginia's 1998 303(d) TMDL Priority List for station 2-MOC005.97 with a violation rate of 3/20 (fecal coliform bacteria). It was downgraded to impaired during the 2002 assessment cycle. In 2008, the upstream, non-tidal station 2-MOC010.97, had an *E. coli* violation rate of 1/12 which was acceptable. As a result, the non-tidal portion of Morris Creek from the headwaters downstream to river mile 6.67 (head of tide) will be de-listed in DEQ's 2010 Integrated Report. However, in 2008, the downstream tidal segment station 2-MOC005.97 had an enterococci violation rate of 4/18. Therefore, the tidal segment, from river mile 6.67 to the confluence of Morris Creek with the Chickahominy River, remains on the 303(d) impaired streams list with a TMDL due date of 2010.

The Virginia state standard specifies that *E. coli* and enterococci bacteria per 100 ml of water shall not exceed the following:

	Geometric Mean[1]	Single Sample Maximum[2]
Freshwater[3] (free-flowing) *E. coli*	126	235
Saltwater and Transition Zone[3] (tidal) enterococci	35	104

Potential sources of fecal coliform consist primarily of non-point source contributions, and include permitted point source discharges in the watershed. Non-point sources include wildlife; livestock; land application of bio-solids; recreational vessel discharges; failed, malfunctioning, or non-operational septic systems; and uncontrolled discharges (straight pipes conveying gray water from kitchen and laundry areas of private homes, etc.).

Virginia DEQ used a simplified volumetric approach to develop the TMDL. The goal of the procedure is to use bacteriological source tracking (BST) data and bathymetric data to determine the sources of bacteria violations. To assist in partitioning the loads from the diverse sources within the watershed, Biological Source Tracking (BST) samples of *E. coli* bacteria were collected monthly for 11 months at the downstream station 2-MOC005.97. These samples were compared to a reference library of samples from known sources. The resulting data were used to assign portions of the load within the watershed to wildlife, humans, pets or livestock. The BST shows that in Morris Creek the largest percentage of bacteria were from wildlife sources followed by human, a minor contribution by pet (primarily dog), and finally, an insignificant portion contributed by livestock. These values were used for the source allocation in deriving the Total Maximum Daily Load in Morris Creek.

[1] For two or more samples taken during any calendar month.
[2] No single sample maximum for enterococci and E. coli shall exceed a 75% upper one-sided confidence limit based on a site-specific log standard deviation. If site data are insufficient to establish a site-specific log standard deviation, then 0.4 shall be used as the log standard deviation in freshwater and 0.7 shall be as the log standard deviation in saltwater and transition zone. Values shown are based on a log standard deviation of 0.4 in freshwater and 0.7 in saltwater.
[3] See 9 VAC 25-260-140 C for freshwater and transition zone delineation.

Load Allocation Scenarios

The next step in the TMDL process was to determine the appropriate water quality standard to be applied. This was determined to be the single sample maximum (or instantaneous max) because DEQ is unable to collect more than one sample per month at each station, due to limited funding and human resources, which is required to calculate the geometric mean standard. The worst case single sample maximum value at the downstream tidal station 2-MOC005.97 was multiplied by the volume, which was calculated by bathymetric data and surface area, and was used to establish the existing bacteria load in Morris Creek. The load necessary to meet the water quality standard for primary contact was calculated using the instantaneous maximum water quality standard criterion for tidal waters multiplied by the volume of the tidal portion of the creek. The difference between these two numbers represents the reduction of bacteria necessary to meet the recreation use water quality standard. TMDL Summary Table ES1 displays the waste load allocation (WLA) of 1% of the total TMDL amount to allow for future growth in the watershed as well as the TMDL amount and load allocation (LA). Table ES2 provides a comprehensive version of the TMDL including the numbers used to calculate the loads, the results of the load calculation, and the percent bacteria reduction necessary for Morris Creek

Table ES1. TMDL Summary for the Morris Creek Watershed

Waterbody	Pollutant Identified	TMDL cfu/day	Waste Load Allocation cfu/day (Future Growth)	Load Allocation cfu/day	Margin of Safety
Morris Creek	Enterococci bacteria	2.92E+12	2.92E+10	2.89E+12	Implicit

Table ES2. Single Sample Maximum (SSM) Analysis of Current Load, Allowable Load, and Load Reduction for Morris Creek

Waterbody	Volume (m^3)	Single Sample Max Enterococci (cfu/100ml)	SSM Water Quality Standard Enterococci (cfu/100mL)	Current Load (cfu/day)	TMDL Allowable Load (cfu/day)	Required Reduction (%)
Morris Creek	2810621	500	104	1.41E +13	2.92E+12	79%

TMDLs seek to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process because fecal bacteria are a serious human health concern in the free-flowing and estuarine environments, and discharge of human waste is prohibited by law. The current and allowable load calculations predict that a 100% reduction in human, pet, and livestock loads plus an additional 53% reduction in wildlife loads to Morris Creek are necessary to improve the water quality so that it is in attainment with the recreation water quality standard, as is shown in Table ES3 below.

Table ES3. Load Allocations Morris Creek
(Based on Single Sample Maximum Water Quality Standard for Enterococci)

Waterbody	Source Type	BST Allocation % of Total Load	Current Load MPN/ day	Load Allocation MPN/ day	Reduction Needed
Morris Creek	Wildlife	44%	6.20E+12	2.92E+12	53%
	Human	32%	4.51E+12	0.00E+00	100%
	Livestock	8%	1.13E+12	0.00E+00	100%
	Pets	16%	2.26E+12	0.00E+00	100%
	Total	**100%**	**1.41E+13**	**2.92E+12**	**79%**

Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative for environmental protection. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

Recommendations for TMDL Implementation

The goal of this TMDL is to develop an allocation plan that achieves water quality standards during the implementation phase. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19.7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters."

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the waterbody in an implementation plan. These measures, which can include the use of better waste treatment technologies, best management practices (BMPs) and even designation of a No Discharge Zone, are implemented in an iterative process that is described along with specific BMP locations and costs in the implementation plan. The TMDL developed for the Morris Creek watershed provides allocation scenarios (shown in Table ES3) as a starting point for developing implementation strategies. Additional monitoring aimed at targeting the necessary reductions is critical to implementation development. Once the implementation strategies are established, continued monitoring will track water quality improvements. Public participation is critical to the implementation process. Reductions in non-point source loading are the crucial factor in addressing the bacteria problem. These sources cannot be addressed without public understanding of and support for the implementation process. Stakeholder input will be critical from the onset of the implementation process in order to develop an implementation plan that will be truly effective.

Public Participation

During development of the TMDL for Morris Creek watershed, public involvement was encouraged through a public participation process that included public and stakeholder meetings.

The first public meetings were held on May 20, 2009. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. The TMDL load allocations were presented during the second public meeting held on July 15, 2009. The public meetings were advertised in the local media, signs were posted around the watershed, and email invitations were sent to local government, citizens and stakeholders. There were XX public comments received.

1.0 Introduction

This document details the development of a bacterial Total Maximum Daily Load (TMDL) of the Morris Creek (G08R-01-BAC) watershed in Charles City County, Virginia. Morris Creek was listed as threatened for primary contact (recreation or swimming) use on Virginia's 1998 303(d) TMDL Priority List for station 2-MOC005.97 with a violation rate of 3/20 (fecal coliform bacteria). It was downgraded to impaired during the 2002 assessment cycle. In 2008, station 2-MOC010.97 had an upstream non-tidal E. coli violation rate of 1/12 which was acceptable. As a result, the non-tidal portion of Morris Creek from the headwaters downstream to rivermile 6.67 at the head of tide will be de-listed in the 2010 Integrated Report. However, the downstream tidal segment station 2-MOC005.97 had an enterococci violation rate of 4/18. Therefore, the tidal segment remained on the 303(d) impaired streams list with a TMDL due date of 2010.

A TMDL is just one step in a multi-step process that includes a high level of public participation in order to address water quality issues that can affect public health and the health of aquatic life. Water quality standards are regulations based on federal or state law that set numeric or narrative limits on pollutants. Water quality monitoring is performed to measure these pollutants and determine if the measured levels are with the bounds of the limits set for the uses designated for the waterbody. The waterbodies which have pollutant levels above the designated standards are considered impaired for the corresponding designated use (e.g. swimming, drinking, shellfish harvest, etc.). The impaired waterways are listed on the §303 (d) list and are reported to the Environmental Protection Agency. Those waters placed on the list require the development of a TMDL intended to eliminate the impairment and bring the water into compliance with the designated standards.

TMDLs represent the total pollutant loading that a water body can receive without violating water quality standards. TMDLs are pollutant specific. The TMDL process establishes the allowable loading of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions.

Section 303(d) of the Clean Water Act and US Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies which are exceeding water quality standards. By following the TMDL process, states can establish water quality based controls to reduce pollution from both point and non-point sources to restore and maintain the quality of their water resources (EPA, 1991).

The Commonwealth of Virginia's (Virginia's) 1997 Water Quality Monitoring, Information, and Restoration Act (WQMIRA) codifies the requirement for the development of TMDLs for impaired waters. Specifically section § 62.1-44.19:7 C states:

"The plan required by subsection A shall, upon identification by the Board of impaired waters, establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters. The Board shall develop and implement pursuant to a schedule total maximum daily loads of pollutants that may enter the water for each impaired water body as required by the Clean Water Act. "

The EPA specifies that in order for a TMDL to be considered complete and approvable, it must include the following eight elements:

1. It must be designed to meet applicable water quality standards,

2. It must include a total allowable load as well as individual waste load allocations and load allocations,
3. It must consider the impacts of background pollution,
4. It must consider critical environmental conditions or those conditions (stream flow, precipitation, temperature, etc.) which together can contribute to a worst-case exceedance of the water quality standard,
5. It must consider seasonal variations which together with the environmental variations can lead to a worst-case exceedance,
6. It must include an implicit or explicit margin of safety to account for uncertainties inherent in the TMDL development process,
7. It must allow adequate opportunity for public participation in the TMDL development process,
8. It must provide reasonable assurance that the TMDL can be met.

Virginia DEQ used a simplified volumetric approach to develop the TMDL. The goal of the procedure is to use bacteriological source tracking (BST) data to determine the sources of bacteria violations and bathymetric data to estimate the estuarine volumes and load reductions needed to attain the applicable criteria. See Chapter 4 for further discussion of BST.

A glossary of terms used throughout this report is presented in Appendix A.

1.1 Overview of the TMDL Development Process

A TMDL study is the first part of a phased process aimed at restoring water quality. This study is designed to determine how much of the pollutant input needs to be reduced in order to achieve water quality standards. The second step in the process is the development of an implementation plan that identifies which specific control measures are necessary to achieve those reductions, their timing for implementation and at what cost. The implementation plan will also outline potential funding sources. The third step will be the actual implementation process. Implementation will typically occur in stages that allow a review of progress in reducing pollutant input, refine bacteria loading estimates based upon additional data and make any identified changes to pollutant control measures. The TMDL development process also must account for seasonal and annual variations in precipitation, flow, land use, and pollutant contributions.

2.0 Designated Uses and Applicable Water Quality Standard

Water quality standards are provisions of state or federal law which consist of a designated use or set of uses for the waters and water quality criteria based upon such uses. The purpose of water quality standards is to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). According to Virginia Water Quality Standards (9 VAC 25-260-5), the term *"water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."*

2.1 Designated Uses and Criteria

Section 9 VAC 25-260-170 is the applicable water quality criteria for impairments in Morris Creek and reads as follows:

A. In surface waters, except shellfish waters and certain waters identified in subsection B of this section, the following criteria shall apply to protect primary contact recreational uses:

1. Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water. This criterion shall not apply for a sampling station after the bacterial indicators described in subdivision 2 of this subsection have a minimum of 12 data points or after June 30, 2008, whichever comes first.

2. E. coli and enterococci bacteria per 100 ml of water shall not exceed the following:

	Geometric Mean[1]	*Single Sample Maximum*[2]
Freshwater[3]		
E. coli	*126*	*235*
Saltwater and Transition Zone[3]		
enterococci	*35*	*104*

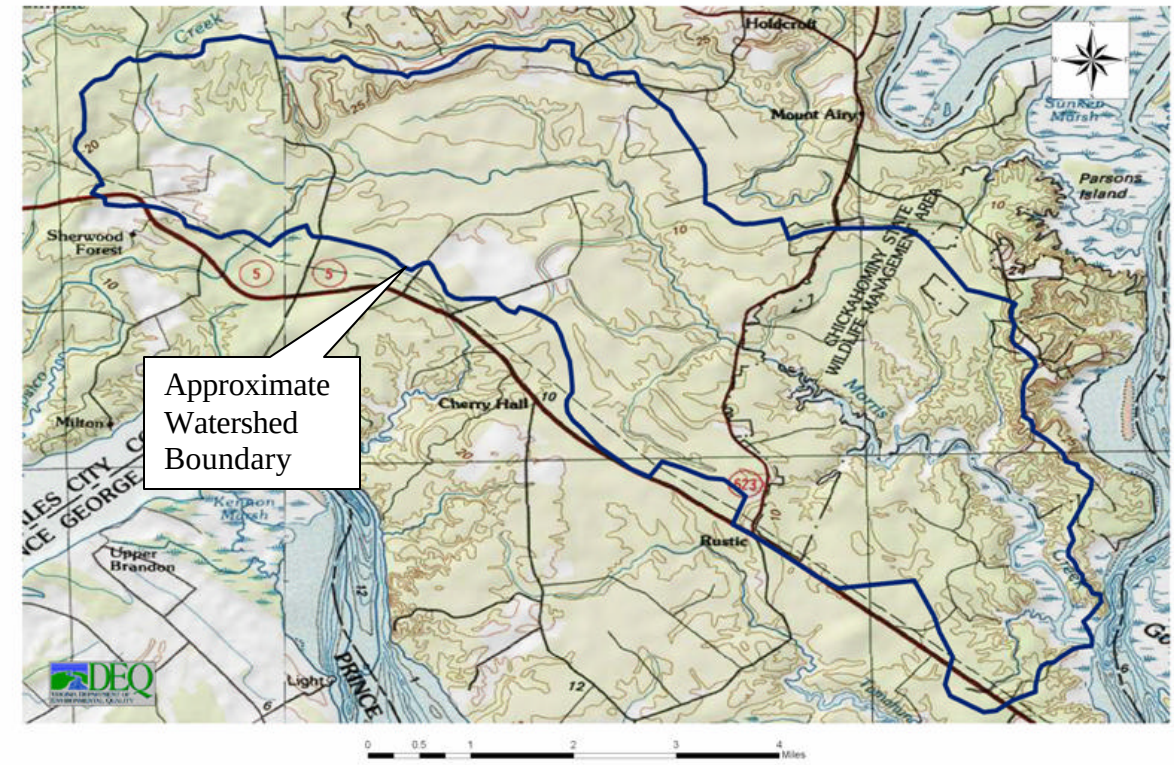
[1] For two or more samples taken during any calendar month.
[2] No single sample maximum for *enterococci* and *E. coli* shall exceed a 75% upper one-sided confidence limit based on a site-specific log standard deviation. If site data are insufficient to establish a site-specific log standard deviation, then 0.4 shall be used as the log standard deviation in freshwater and 0.7 shall be as the log standard deviation in saltwater and transition zone. Values shown are based on a log standard deviation of 0.4 in freshwater and 0.7 in saltwater.
[3] See 9 VAC 25-260-140 C for freshwater and transition zone delineation.

3.0 Watershed Characterization

Morris Creek (VAP-G08R-01-BAC) is located within Charles City County, Virginia and is a minor tributary to the Chickahominy River (Figure 3.0). It is approximately 13.4 miles long and flows south-east from its headwaters near Ruthville, VA to its confluence with the Chickahominy River. The watershed has an area of approximately 12.7 square miles. Charles City County has a combined land and water area of 182.76 square miles (http://quickfacts.census.gov/qfd/states/51/51036.html). There is no continuous flow gauging station on Morris Creek, however there is a gage on Totopotomoy Creek near Studley, VA, 01673550, which is located 26 miles northwest of Morris Creek, with a drainage area of 26.2 mi^2. Charles City County has an estimated population according to the 2008 US Census of 7,212. Aerial photos from 2002 show 97 "homes" in the Morris Creek watershed (buildings which are interpreted as residences). At 2.59 people per home estimated in 2000 Census data, there are approximately 251 people residing in the Morris Creek watershed.

There is one permitted National Pollution Discharge and Elimination System (NPDES) facility, Mt. Zion Rustic Water Treatment Plant (VA0085936), which discharges to the Morris Creek watershed. It is not permitted for bacteria nor is the facility required to monitor for a bacteria surrogate, total residual chlorine. Permitted facilities are discussed in section 4.2.

Figure 3.0 Morris Creek Watershed Map



Land Use

Land use in the watershed is shown in Figures 3.1 and 3.2 and Table 3.0. In Morris Creek, approximately 65% of the land use in the watershed is undeveloped forest. 12% of land use is comprised of undeveloped wetlands and reflects the portion of the watershed area occupied by Morris Creek itself. Agriculture occupies 21% of the land and is divvied up by 10% pasture and 11% crop land. Barren land, which may be fallow or cleared land, totals approximately 2% of the landscape. Land use data was obtained from the United States Geological Survey National Land Cover Dataset (USGS NLCD), 2001.

Figure 3.1 Morris Creek Land Use Map

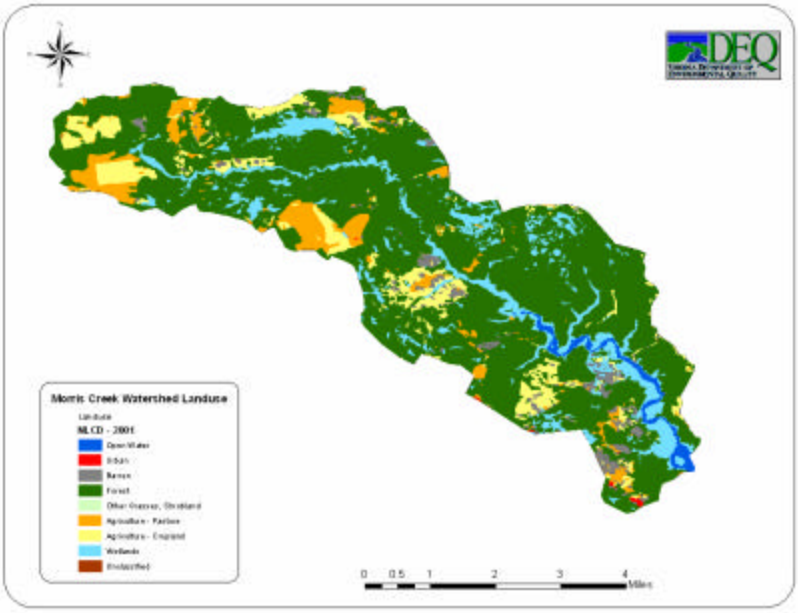
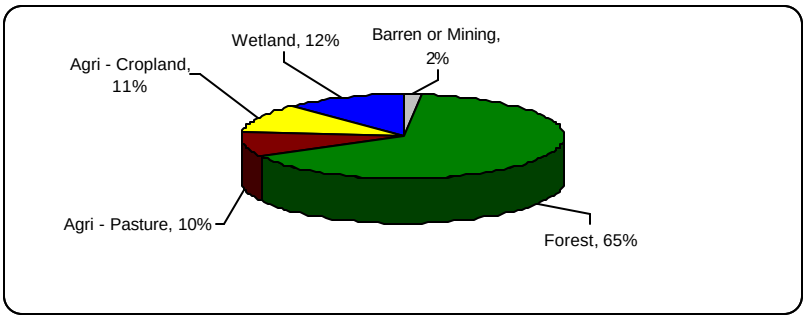


Table 3.0 Morris Creek Watershed Percentages by Land Use Type

Land Use Type	Acres	Square Miles	Percent
Open Water	0	0	0%
Urban	1.47	0	0%
Barren or Mining	167.47	0.26	2%
Transitional	0	0	0%
Forest	5311.24	8.3	65%
Agri - Pasture	781	1.22	10%
Agri - Cropland	886.36	1.38	11%
Wetland	983	1.54	12%
Totals:	**8130.54**	**12.7**	**100%**

Figure 3.2 Morris Creek Land Use



3.1 Geology and Soils

Morris Creek lies in the Atlantic Coastal Plain physiographic region. The Atlantic Coastal Plain is the easternmost of Virginia's physiographic provinces. The Atlantic Coastal Plain extends from New Jersey to Florida and includes all of Virginia east of the Fall Line. The Fall Line is the easternmost extent of rocky-river rapids, the point at which east-flowing rivers cross from the hard, igneous and metamorphic rocks of the Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain. The Coastal Plain is underlain by layers of Cretaceous and younger clay, sand, and gravel that dip gently eastward. These layers were deposited by rivers carrying sediment from the eroding Appalachian Mountains to the west. As the sea level rose and fell, fossiliferous marine deposits were inter-layered with fluvial, estuarine, and beach strata. The youngest deposits of the Coastal Plain are sand, silt and mud presently being deposited in our bays and along our beaches.

Soils for the Morris Creek watershed were documented utilizing the VA State Soil Geographic Database (STATSGO). Four general soil types were identified using in this database. Descriptions of these soil series were derived from queries to the USDA Natural Resources Conservation Service (NRCS) Official Soil Series Description web site (http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi). Figure 3.3 shows the location of these general soil types in the watershed.

Soils of the Emporia-Johnston-Kenansville-Remlik-Slagle-Suffolk-Tomotley-Rumsford Series (VA027) are very deep and range from very poorly to excessively drained conditions. Permeability is slow to moderately rapid. These soils formed out of loamy and sandy sediments, marine sediments and deposits, alluvium, and fluvial sediments along the uplands, sideslopes, floodplains, swamps, and marine terraces of the lower and upper Coastal Plain.

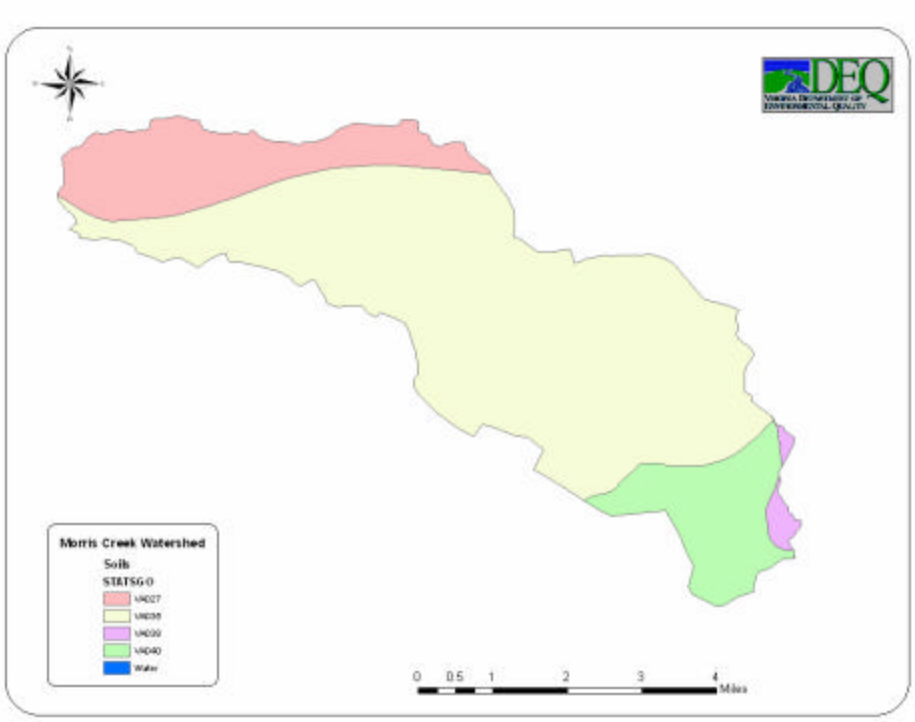
Soils of the Mattoponi-Lenoir-Craven-Coxville Series (VA035) are very deep and range from poorly to well drained conditions. Permeability is slow to moderately slow. These soils formed from fluvial,

marine, and clayey sediments and marine deposits along the uplands, flats, depressions, and Carolina bays of the lower to upper Coastal Plain and Piedmont physiographic regions.

Soils of the Pamunkey-Nansemond-Bibb-Kinston-Nawney-Bohicket (VA038) Series are very deep and are poorly to well drained. Permeability is very slow to moderately rapid. These soils formed from loamy—marine and stratified fluvial sediments, stratified loamy and sandy alluvium, loamy, silty, and clayey marine sediment type parent materials. They formed along nearly level to sloping terraces, floodplains, and tidal marshes of the Coastal Plain and Piedmont.

Soils of the Bojac-Pamunkey-Munden-Angie-Augusta-Molena-Argent Series (VA040) are very deep and range from excessivley to poorly drained conditions. Permeability is moderately rapid to slow. This series is found along terraces and uplands and is composed of loamy—sandy fluvial and marine Coastal Plain sediments.

Figure 3.3 Morris Creek Soils Map

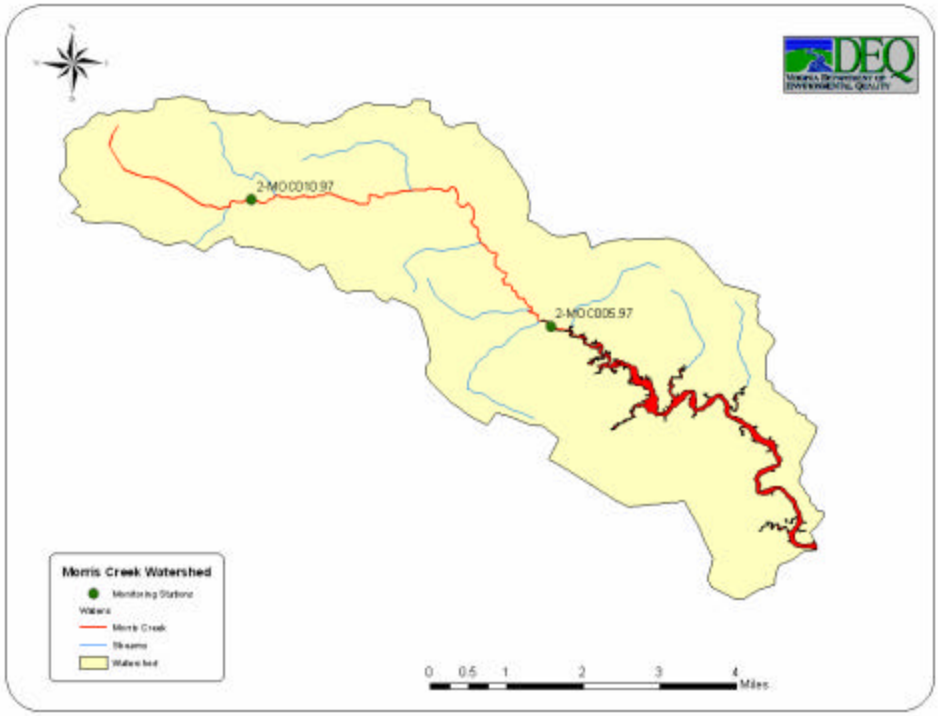


4.0 Water Quality Impairment and Bacterial Source Assessment

4.1 Water Quality Monitoring

The water quality monitoring network for Morris consists of 2 monitoring stations. The upper station is monitored for E. coli bacteria which is the pathogenic biological indicator utilized by DEQ in fresh, free-flowing waters. The lower station is monitored for enterococci which is used as the pathogenic indicator in tidal-fresh and saltwater bodies. The locations of the water quality monitoring stations utilized for this study are shown in Figure 4.0.

Figure 4.0 Morris Creek Watershed Impairment Map



This TMDL study examined bacterial monitoring data at these stations for a period from December 2005 through November 2008. A summary of water quality data from the stations for the monitoring period preceding the TMDL study is shown in Tables 4.0 and 4.1. Graph Figures 4.1 and 4.2 depict the changes in bacteria levels within Morris Creek during the sampling periods.

Table 4.0 Water Quality Data Summary: Morris Creek Enterococci (tidal) data

Station 2-MOC005.97 Collection Date	Enterococci cfu/100ml	Exceeds Tidal WQS of 104 cfu/100 ml
12/20/2005	25.0000	No
2/15/2006	25.0000	No
4/19/2006	50.0000	No
6/20/2006	100.0000	No
8/28/2006	50.0000	No
10/23/2006	75.0000	No
12/5/2006	120.0000	Yes
3/1/2007	25.0000	No
5/17/2007	25.0000	No
7/17/2007	500.0000	Yes
9/18/2007	400.0000	Yes
11/28/2007	100.0000	No
1/9/2008	100.0000	No
3/17/2008	100.0000	No
5/15/2008	100.0000	No
7/1/2008	100.0000	No
9/3/2008	100.0000	No
11/5/2008	200.0000	Yes

Figure 4.1 Water Quality Data Summary: Morris Creek Enterococci (tidal) data

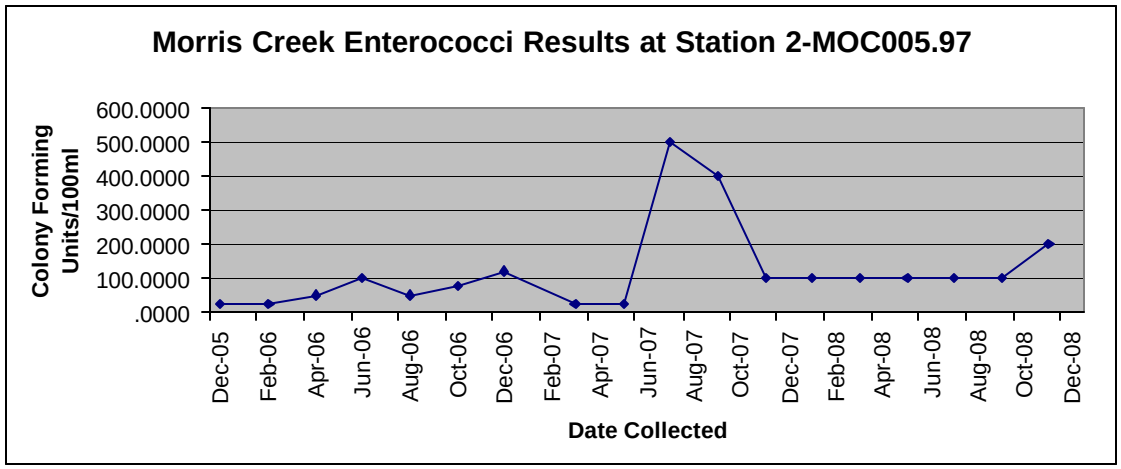
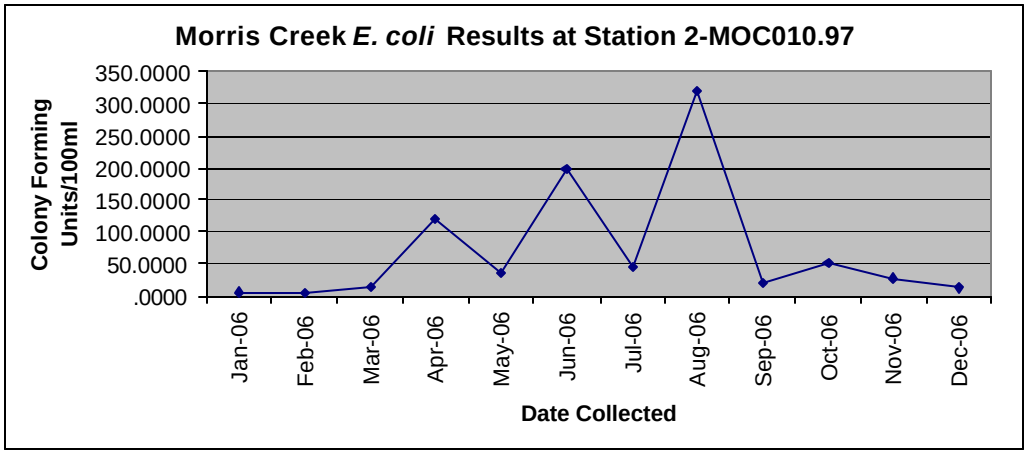


Table 4.1 Water Quality Data Summary: Morris Creek *E. coli* (non-tidal) data

Station 2-MOC010.97 Collection Date	*E. coli* cfu/100ml	Exceeds Non-tidal WQS Standard 235 cfu/100ml
1/17/2006	7.0000	No
2/21/2006	5.0000	No
3/20/2006	15.0000	No
4/26/2006	120.0000	No
5/15/2006	37.0000	No
6/20/2006	200.0000	No
7/24/2006	45.0000	No
8/22/2006	320.0000	Yes
9/27/2006	20.0000	No
10/23/2006	53.0000	No
11/15/2006	28.0000	No
12/11/2006	13.0000	No

Figure 4.2 Water Quality Data Summary: Morris Creek *E. coli* (non-tidal) data



The single sample maximum criteria states that the standard may not be violated more than 10.5% of the time, which is equal to a violation rate. The monitoring data collected at the upstream, non-tidal station 2-MOC010.97 shows an improvement of water quality. The current violation rate (8.3%) is

less than 10.5%, meaning it is scheduled to be removed from DEQ's impaired waters list during the 2010 assessment cycle. Therefore, for the purposes of this water quality study, calculations for bacteria loading will focus on the tidal, downstream station of Morris Creek, 2-MOC005.97, which has a violation rate (22.2%) exceeding 10.5%.

4.2 Bacteria Source Assessment

A. Point Source

There is one point-source NPDES permit, Mt. Zion Rustic WTP (VA0085936) which discharges to Morris Creek. Mt. Zion Rustic WTP is a water treatment facility. It is not permitted for bacterial discharge nor does it monitor for total residual chlorine, a bacteria surrogate. There are no loads assigned to any current point source dischargers in the Morris Creek watershed because there currently are no known, permitted dischargers of bacteria to the watershed. To account for any development which might occur subsequent to this TMDL, A future growth factor of 1% of the total TMDL number has been assigned as the wasteload allocation (WLA)

B. Non-Point Source

Non-point sources of bacteria do not have one discharge point but may occur over the entire shoreline of the receiving water. Bacteria (specifically *E. coli* and Enterococci) are deposited on the land surface and build up over time. During rain events, surface runoff transports water, sediment and bacteria to waterways. Sources of bacteria include grazing livestock, concentrated animal feeding operations, manure application, wildlife, and pet excretion. Direct contribution to the waterway occurs when livestock or wildlife defecate into or immediately adjacent to receiving waters. Non-point source contributions from humans generally arise from failing septic systems and drain fields, moored or marina vessel discharges, storm water management facilities, pump station failures, and ex-filtration from sewer systems. Contributions from wildlife, both mammalian and avian, are natural conditions and represent a background level of bacterial loading. In areas where there may be nuisance wildlife populations, the assistance of the Department of Game and Inland Fisheries may be requested for evaluation.

Estimations of the populations of livestock, pets, and wildlife, as well as the number of mal-functioning septic systems within the watershed are shown in Tables 4.2 and 4.3. Appendix A: Supporting Documentation and Watershed Assessment, provides a description of calculation methods and a list of population data sources used in deriving the numbers below.

Table 4.2 Domestic Animals Observed Contributing Pollution in Morris Creek Watershed
(As sited by visual observations from DEQ staff, Charles City Co staff observations, and citizens in Spring 2009)

Bacteria Source Type	Number Observed
Sheep/Goat	185
Horses	1
Dogs	425

Table 4.3 Estimates of Morris Creek Animal Populations and Septic Failures
(Dog & Horse Estimates from US American Veterinary Association, Livestock numbers from USDA Livestock Census 2007)

Cattle	Chicken	Deer	Beaver	Muskrat	Raccoon	Ducks	Geese	Septic Failures
20	20	450	65	9800	500	50	65	12

There are 3 records of permitted biosolid applications within the Morris Creek watershed. Biosolids, or sewage sludge, is obtained from public or private sewage treatment facilities via DEQ permit and may be applied to crop lands with an approved Nutrient Management Plan (NMP). Comparison of the monitoring data with dates of biosolid applications within the watershed do not indicate an increase in bacteria loads due to biosolids applications. There is no record of poultry litter or manure being delivered or applied within the vicinity of Charles City County. Citizens of the watershed could not verify that any poultry litter or manure applications had taken place.

4.3 Bacterial Source Tracking

Bacterial Source tracking is used to identify sources of fecal contamination from human as well as domestic and wild animals. The BST method used in Virginia is based on the premise that *Escherichia coli (E. Coli)* found in human, pets, livestock, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Analysis (ARA) uses *E. coli* and patterns of antibiotic resistance for separation of sources of the bacterial contribution. The BST analysis used for this TMDL classified the bacteria into one of four source categories: human, pets, livestock, and wildlife. However, BST analysis is an inexact technique that is still under evaluation and error exists in correctly assigning *E. coli* isolates to the appropriate fecal sources. BST is a general tool for making a broad determination of bacterial source, therefore BST percentages should not be considered precise.

The sampling locations were selected by DEQ to represent drainage from discrete areas within the watershed, yet the watershed areas could not be so small as to require more stations than could be analyzed under the budget limitations. The BST sampling period was January 2006 through December 2006. The target sampling interval was once monthly. Table 4.4 displays the BST station summary and Table 4.5 shows the BST results for Morris Creek. BST percentages were weighted by the number of isolates, the E. coli concentration, and the volume of impaired water in Morris Creek. Thus the higher the number of isolates, the E. coli concentration and the volume, the more weight an individual sample was given in calculating the BST source percentages. Table 4.6 shows the weighted average BST for each of the non-point source categories. The BST weighted percentage chart for Morris Creek is shown in Figure 4.3. The BST results at station 2-MOC005.97 suggest that the largest percentage of bacteria source is from wildlife, followed by human, and relatively insignificant levels of livestock and pet. These values were used for the source allocation in deriving the Total Maximum Daily Loads for Morris Creek.

Table 4.4 Summary of Bacterial Source Tracking (BST) in Morris Creek

Station Number	Hydrologic Unit Code (HUC)	County	Waterbody	# Samples Analyzed
2-MOC005.97	G08	Charles City	Morris Creek	11

Table 4.5 Bacteria Source Tracking results for Morris Creek at Station 2-MOC005.97

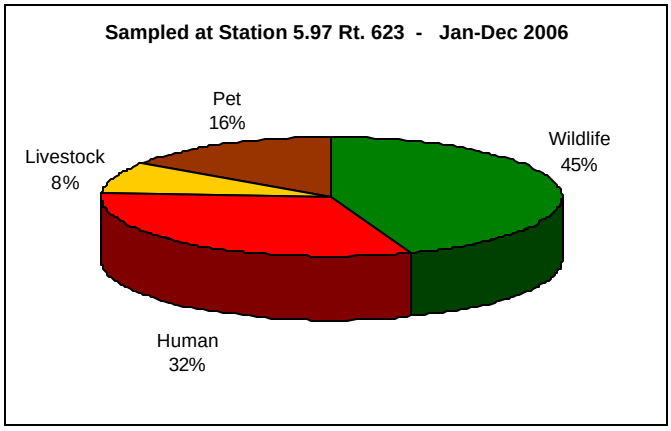
VADEQ ID	Date of Sample	*E. coli* (cfu/100 ml)	Number of Isolates	Wildlife	Human	Livestock	Pet
2MOC005.97	1/17/06	279	24	**38%**	**33%**	12%	**17%**
2MOC005.97	2/21/06	6	2	50%	50%	0%	0%
2MOC005.97	3/20/06	114	24	**88%**	4%	4%	4%
2MOC005.97	4/26/06	98	23	**43%**	**22%**	0%	**35%**
2MOC005.97	5/15/06	290	24	**29%**	**67%**	0%	4%
2MOC005.97	7/24/06	100	22	**95%**	0%	0%	5%
2MOC005.97	8/22/06	176	15	**100%**	0%	0%	0%
2MOC005.97	9/27/06	140	24	4%	**17%**	**46%**	**33%**
2MOC005.97	10/23/06	84	24	0%	**67%**	0%	**33%**
2MOC005.97	11/15/06	44	24	**50%**	4%	4%	**42%**
2MOC005.97	12/11/06	18	5	20%	40%	20%	20%

BOLD type indicates a statistically significant value.

Table 4.6 BST Results Morris Creek
Weighted by Average Isolate, Concentration, and Volume BST
(Volumes were calculated by DEQ staff using bathymetry measurements taken Spring 2009 and surface area measurements)

Livestock	Wildlife	Human	Pet
8%	**45%**	**32%**	**16%**

Figure 4.3 Morris Creek Average Weighted BST Percentages



5.0 TMDL Development

Virginia DEQ used a simplified volumetric approach to develop the TMDL. The goal of the procedure is to use bacteriological source tracking (BST) data to determine the sources of bacteria violations and bathymetric data to estimate the volumes and load reductions needed to attain the applicable criteria.

5.1 The TMDL Calculation

As stated previously, the non-tidal station is currently meeting water quality standards and the upstream portion of Morris Creek is expected to be removed from DEQ's impaired waters list in the 2010 assessment cycle. Therefore, the data collected at the tidal, downstream station which currently violates the water quality standard for primary contact, will be used to calculate the current bacteria load.

To calculate the current loading for the tidal section using station (2-MOC005.97), DEQ multiplied the worst violation, which occurred on 7/17/07 with a result of 500 enterococci/100mL, by the volume of the impaired portion of Morris Creek (2810621 m^3).

The allowable load was calculated using the water quality standard of 104 cfu/100ml enterococci, multiplied by the volume. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load. The calculated results are listed in Table 5.0. The estimates are calculated as follows:

Current Load = Largest Single Sample Maximum value (# cfu/100ml) x Volume of impaired water (m^3)

Allowable Load = Criteria Value (104 cfu/100ml) x Volume of impaired water (m^3)

$$\text{Load Reduction} = \frac{\text{Current Load} - \text{Allowable Load}}{\text{Current Load}} \times 100\ \%$$

Table 5.0 Single Sample Maximum (SSM) Analysis of Current Load, Allowable Load, and Load Reduction for Morris Creek

Waterbody	Volume (m^3)	Single Sample Max Enterococci (cfu/100ml)	SSM Water Quality Standard Enterococci (cfu/100mL)	Current Load (cfu/day)	TMDL Allowable Load (cfu/day)	Required Reduction (%)
Morris Creek	2810621	500	104	1.41E +13	2.92E+12	79%

5.2 Load Allocation

Based on the source assessment of the watershed, the percent loading for each of the major source categories are estimated. These percentages are used to determine where load reductions are needed. The loadings for each source are determined by multiplying the total current and allowable loads by the representative percentages. The percent reduction needed to attain the water quality standard or criterion is allocated to each source category. This is shown in Table 5.1 and serves to fulfill the TMDL requirements by ensuring that the criterion is attained.

Table 5.1 Load Allocations Morris Creek
(Based on Single Sample Maximum Water Quality Standard Enterococci)

Waterbody	Source Type	BST Allocation % of Total Load	Current Load MPN/ day	Load Allocation MPN/ day	Reduction Needed
Morris Creek	Wildlife	44%	6.20E+12	2.92E+12	53%
	Human	32%	4.51E+12	0.00E+00	100%
	Livestock	8%	1.13E+12	0.00E+00	100%
	Pets	16%	2.26E+12	0.00E+00	100%
	Total	**100%**	**1.41E+13**	2.92E+12	**79%**

The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process. Human derived fecal coliforms are a serious

concern in the free-flowing and tidal environments and discharge of human waste is precluded by state and federal law. Therefore a 100% reduction in human load is required for Morris Creek The TMDL calculations also indicate that a 100% reduction in both livestock and pet sources as well as an additional 53% reduction in wildlife source contributions are necessary in order to meet the water quality standards for recreation use in this creek.

It may be difficult to attain the water quality standard by the largest feasible reductions in human, pet livestock, and wildlife load sources. This is discussed in Section 6.3D below. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that no further reductions are necessary or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis (UAA) for the waterbody (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDL could be implemented to achieve water quality standards; however, the state reserves the right to allocate differently, as long as consistency with the achievement of water quality standards is maintained.

A. Development of Wasteload Allocations

There is one permitted point source discharge in the watershed, Mount Zion Water Treatment Plant (VA0085936). This facility is not permitted for bacterial discharge and therefore is not assigned a waste load allocation (WLA). A wasteload allocation for future growth of 1 percent of the total load allocation has been included in the TMDL. The WLA assigned for this TMDL is located in Table 5.2 below.

5.3 Consideration of Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. The current loading to the waterbody was determined using the worst violation of DEQ water quality monitoring (observation) data at the tidal Morris Creek station. The period of record for the data was 2005 to 2008.

It is the reductions based on these bacterial loadings that will yield attainment of the water quality standard. Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. Variations due to changes in the hydrologic cycle as well as temporal variability in bacteria sources, such as migrating waterfowl populations, are accounted for by the use of monthly data to estimate the current load.

5.4 Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load

calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

5.5 TMDL Summary

Table 5.2 TMDL Summary for the Morris Creek Watershed

Waterbody	Pollutant Identified	TMDL cfu/day	Waste Load Allocation cfu/day (Future Growth)	Load Allocation cfu/day	Margin of Safety
Morris Creek	Enterococci bacteria	2.92E+12	2.92E+10	2.89E+12	Implicit

6.0 TMDL Implementation

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. This report represents the culmination of that effort for the bacteria impairments in the Morris Creek watershed. The second step is to develop a TMDL implementation plan. The final step is to implement the TMDL implementation plan and to monitor water quality to determine if water quality standards are being attained.

Though the upstream, non-tidal portion of Morris Creek is currently meeting water quality standards, it is suspected of contributing bacteria to the tidal impairment. During Implementation Planning, it will be necessary to address bacterial sources in the non-tidal as well as the tidal segments of Morris Creek in order to reach attainment of the water quality standards.

Once a TMDL has been approved by EPA, measures should be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technology, the installation of best management practices (BMPs) and even designation of No Discharge Zones, are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The process for developing an implementation plan has been described in the recent "TMDL Implementation Plan Guidance Manual," published in July 2003 and available upon request from the DEQ and DCR TMDL project staff or at http://www.deq.state.va.us/tmdl/implans/ipguide.pdf . With successful completion of implementation plans, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, having an approved implementation plan will improve a locality's chances for obtaining financial and technical assistance during implementation.

6.1 Staged Implementation

In general, Virginia intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. For example, in agricultural areas of the watershed, the most promising management practice is livestock exclusion from waterbodies. This has been shown to be very effective in lowering fecal coliform concentrations in waterbodies, both by reducing the cattle deposits themselves and by providing additional riparian buffers.

Additionally, in both urban and rural areas, reducing the human fecal loading from failing septic

systems should be a primary implementation focus because of its health implications. This component could be implemented through education on septic tank pump-outs as well as a septic system repair/replacement program and the use of alternative waste treatment systems. In sewered areas, reducing the loading from leaking sewer lines could be accomplished through a sanitary sewer inspection and management program. Pump-outs of septic tanks are required every 5 years and are required by the Chesapeake Bay Act. Charles City County's Septic System Ordinance (Article VII, Section 4.3) dictates that as of July 1, 1995, all septic systems throughout the county shall be pumped and maintained once every five years. Owners of septic systems supply the local Health Department with proof that this maintenance is performed. Failure to comply with this county ordinance may result in fines and liens against the owner's property.

Though the BST analysis does not indicate pets as a major source of bacteria in the watershed, there is the possibility that there is a pet population that is seasonal due to the proximity of several hunt club kennels to the watershed. Pet waste-scooping education and septic systems for large kennels or hunt clubs may be beneficial not only to reductions of fecal bacteria in the Morris Creek watershed, but also to Charles City County as a whole.

Education could be made available to homeowners, farmers, and businesses concerning the importance of maintaining the Chesapeake Bay Act's requirement of observing a 100' riparian buffer along all creeks and tributaries of the Bay. Protecting existing buffers in addition to restoring buffers which have been destroyed are relatively inexpensive but exceptionally effective methods of reducing runoff which carry with it bacteria, nutrients, and even chemicals to the Bay. Riparian buffers serve as "strainers" which prevent the entry of such components to the waterway.

In waterbodies with significant boat traffic, the designation of a No Discharge Zone should effectively reduce bacterial loads to the impaired segments. A No Discharge Zone in the Lynnhaven River in Virginia Beach, VA., resulted in a major portion of the estuary being opened for shellfish harvesting (another type of bacteria impairment) for the first time in memory and thus has significantly improved water quality.

The iterative implementation of BMPs in the watershed has several benefits:

1. It enables tracking of water quality improvements following BMP implementation through follow-up monitoring.
2. It provides a measure of quality control, given the uncertainties inherent in TMDL loading calculations.
3. It provides a mechanism for developing public support through periodic updates on BMP implementation and water quality improvements.
4. It helps ensure that the most cost effective practices are implemented first.
5. It allows for the evaluation of the adequacy of the TMDL in achieving water quality standards.

Watershed stakeholders will have opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as part of the implementation plan development.

6.2 Link to ongoing Restoration Efforts

Implementation of this TMDL will contribute to on-going water quality improvement efforts aimed at restoring water quality in the Morris Creek. The efforts of such agencies as the Colonial Soil and Water Conservation District are ongoing in the watershed. They and other agencies or groups are likely to be interested in working with stakeholders during the implementation planning for development of BMPs.

A tributary strategy has been developed to address nutrient and sediment reductions for the James River. Up-to-date information on tributary strategy development can be found at http://www.snr.state.va.us/Initiatives/WaterQuality/FinalizedTribStrats/james.pdf.

6.3 Reasonable Assurance for Implementation

A. Follow-Up Monitoring

VADEQ will continue to use data from these monitoring stations to evaluate reductions in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard.

B. Regulatory Framework

While section 303(d) of the Clean Water Act and current EPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (the "Act") directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7). The Act also establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits and environmental impacts of addressing the impairments. EPA outlines the minimum elements of an approvable implementation plan in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include implementation actions/management measures, timelines, legal or regulatory controls, time required to attain water quality standards, monitoring plans and milestones for attaining water quality standards.

Once developed, DEQ intends to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP), in accordance with the Clean Water Act's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and DEQ, DEQ also submitted a draft Continuous Planning Process to EPA in which DEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

C. Implementation Funding Sources

One potential source of funding for TMDL implementation is Section 319 of the Clean Water Act. Other funding sources for implementation include the U.S. Department of Agriculture's Conservation Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, the VA Agricultural Best Management Cost Share Program, the Chesapeake Bay Restoration Fund, the Virginia Environmental Endowment, the National Fish and Wildlife Foundation, and the Virginia Water Quality Improvement Fund. The TMDL Implementation Plan Guidance Manual contains additional information on funding sources, as well as government agencies that might support implementation efforts and suggestions for integrating TMDL implementation with other watershed planning efforts.

D. Addressing Wildlife Contributions

In some waters for which TMDLs have been developed, water quality source identification indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream may not attain standards under all flow regimes at all times. **However, neither the Commonwealth of Virginia nor EPA is proposing the elimination of wildlife to allow for the attainment of water quality standards.** This is obviously an impractical and wholly undesirable action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL.

Based on the above, EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop a reduction goal. The pollutant reductions for the interim goal are applied only to controllable, anthropogenic sources identified in the TMDL, setting aside any control strategies for wildlife. During the first implementation phase all controllable sources would be reduced to the maximum extent practicable using the staged approach outlined above. Following completion of the first phase, DEQ would re-assess water quality in the stream to determine if the water quality standard is attained. This effort will also evaluate if the technical assumptions were correct.

If water quality standards are not being met, a special study called a Use Attainability Analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources, including wildlife. The outcomes of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s). To remove a designated use, the state must demonstrate 1) that the use is not an existing use, 2) that downstream uses are protected, and 3) that the source of bacterial contamination is natural and uncontrollable by effluent limitations and by implementing cost-effective and reasonable best management practices for non-point source control (9 VAC 25-260-10). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process. Additional information can be obtained at http://www.deq.state.va.us/wqs/WQS03AUG.pdf

7.0 Public Participation

During development of the TMDL for Morris Creek watershed, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first public meetings were held on May 20, 2009. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. The TMDL load allocations were presented during the second public meeting held on July 15, 2009. The public meetings were advertised in the local media, signs were posted around the watershed, and email invitations were sent to local government and stakeholders. There were XX public comments received.

8.0 Glossary

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

Allocations. That portion of receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. (A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

Ambient water quality. Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

Anthropogenic. Pertains to the [environmental] influence of human activities.

Bacteria. Single-celled microorganisms. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Bacterial source tracking (BST). A collection of scientific methods used to track sources of fecal contamination.

Best Management Practices (BMPs). Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Biosolids. Also known as Sewage sludge, is the name for the solid, semisolid, or liquid materials removed during the treatment of domestic sewage in a treatment facility. Biosolids include, but are not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings, and sewage sludge products. When properly treated and processed, sewage sludge becomes "biosolids" which can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

Clean Water Act (CWA). The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

Concentration. Amount of a substance or material in a given unit volume of solution; usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Contamination. The act of polluting or making impure; any indication of chemical, sediment, or biological impurities.

Cost-share program. A program that allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The remainder of the costs is paid by the producer(s).

Critical condition. The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

Designated uses. Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

Domestic wastewater. Also called sanitary wastewater, consists of wastewater discharged from residences and from commercial, institutional, and similar facilities.

Drainage basin. A part of a land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. Also referred to as a watershed, river basin, or hydrologic unit.

Existing use. Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).
Fecal Coliform. Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract.
Geometric mean. A measure of the central tendency of a data set that minimizes the effects of extreme values.
GIS. Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989)
Infiltration capacity. The capacity of a soil to allow water to infiltrate into or through it during a storm.
Interflow. Runoff that travels just below the surface of the soil.
Loading, Load, Loading rate. The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in weight per unit time.
Load allocation (LA). The portion of a receiving waters loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)).
Loading capacity (LC). The greatest amount of loading a water body can receive without violating water quality standards.
Margin of safety (MOS). A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body (CWA section 303(d)(1)©). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by EPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).
Mean. The sum of the values in a data set divided by the number of values in the data set.
Monitoring. Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.
Narrative criteria. Non-quantitative guidelines that describe the desired water quality goals.
Nonpoint source. Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.
Nutrient Management Plan. Nutrient management plans provide nutrient recommendations based on realistic expected crop yield, existing nutrient levels in the soil, appropriate timing and placement of nutrients and other normal farming practices related to efficient nutrient utilization, with particular emphasis on environmentally sensitive areas.
Numeric targets. A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.
Point source. Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water waterbody or river.
Pollutant. Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).

Pollution. Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Poultry Litter. Dry excremental waste from poultry, sometimes combined with bedding materials.

Privately owned treatment works. Any device or system that is (a) used to treat wastes from any facility whose operator is not the operator of the treatment works and (b) not a publicly owned treatment works.

Public comment period. The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Publicly owned treatment works (POTW). Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

Raw sewage. Untreated municipal sewage.

Receiving waters. Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Riparian areas. Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.

Riparian zone. The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.

Runoff. That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

Septic system. An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Sewer. A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers handle both.

Slope. The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04), degrees (2 degrees 18 minutes), or percent (4 percent).

Stakeholder. Any person with a vested interest in the TMDL development.

Surface area. The area of the surface of a waterbody; best measured by planimetry or the use of a geographic information system.

Surface runoff. Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.

Surface water. All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.

Topography. The physical features of a geographic surface area including relative elevations and the positions of natural and man-made features.

Total Maximum Daily Load (TMDL). The sum of the individual wasteload allocations

(WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

VADEQ. Virginia Department of Environmental Quality.

VDH. Virginia Department of Health.

VDH-DSS. Virginia Department of Health Division of Shellfish Sanitation.

Virginia Pollutant Discharge Elimination System (NPDES). The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.

Wasteload allocation (WLA). The portion of a receiving waters' loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).

Wastewater. Usually refers to effluent from a sewage treatment plant. See also **Domestic wastewater**.

Wastewater treatment. Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.

Water quality. The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.

Water quality criteria. Levels of water quality expected to render a body of water suitable for its designated use, composed of numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water quality standard. Law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

Watershed. A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

WQIA. Water Quality Improvement Act.

9.0 Citations

VA DEQ 1998 303(d) List of Impaired Waters.

10.0 Appendices

Appendix A Supporting Documentation and Watershed Assessment

Appendix B Water Quality Data

Appendix C Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.

Appendix D Public Comments

Appendix A: Supporting Documentation and Watershed Assessment

A.1 Fecal Production Literature Review
A.2 Geographic Information System Data: Sources and Process
A.3 GIS Data Description and Process
A.4 Population Numbers

A.1 Fecal Production Literature Review

	Concentration in feces		Fecal coliform production rate		Comments
	FC/g	Ref.	FC/day (seasonal)	Ref.	
Cat	7.9E+06	1	5.0E+09	4	
Dog	2.3E+07	1	5.0E+09	4	
Chicken	1.3E+06	1	1.9E+08	4	
Chicken			2.4E+08	9	
Cow	2.3E+05	1	1.1E+11	4	average of dairy and beef
Beef cattle			5.4E+09	9	
Deer	1.0E+02	6	2.5E+04	6	assume 250 g/day
Deer	?		5.0E+08	9	best prof. judgment
Duck			4.5E+09	4	average of 3 sources
Duck	3.3E+07	1	1.1E+10	9	
Canada Geese			4.9E+10	4	
Canada Geese	3.6E+04	3	9.0E+06	3	
Canada Geese	1.5E+04	8	3.8E+06	8	assume 250 g/day (3)
Horse			4.2E+08	4	
Pig	3.3E+06	1	5.5E+09	4	
Pig			8.9E+09	9	
Sea Gull	3.7E+08	8	3.7E+09	8	assume 10 g/day
Sea gull			1.9E+09	5	mean of four species
Rabbit	2.0E+01	2	?		
Raccoon	1.0E+09	6	1.0E+11	6	assume 100 g/day
Sheep	1.6E+07	1	1.5E+10	4	
Sheep			1.8E+10	9	
Turkey	2.9E+05	1	1.1E+08	4	
Turkey			1.3E+08	9	
Rodent	1.6E+05	1	?		
Muskrat	3.4E+05	6	3.4E+07	6	
Human	1.3E+07	1	2.0E+09	4	
Septage	4.0E+05	7	1.0E+09	7	assume 70/gal/day/person

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4. U.S. Environmental Protection Agency. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water (4503F), United States Environmental Protection Agency, Washington, DC. 132 pp.
5. Gould, D. J. and M. R. Fletcher. 1978. Gull droppings and their effects on water quality. Wat. Res. 12:665-672.
6. Kator, H. and M. W. Rhodes. 1996. Identification of pollutant sources contributing to degraded sanitary water quality in Taskinas Creek National Estuarine Research Reserve, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 336, The College of William and Mary, VIMS/School of Marine Science.
7. Kator, H., and M. W. Rhodes. 1991. Evaluation of Bacteroides fragilis bacteriophage, a candidate human-specific indicator of fecal contamination for shellfish-growing waters. A final report prepared under NOAA Cooperative Agreement NA90AA-H-FD234. Prepared and submitted to NOAA, Southeast Fisheries Science Center, Charleston Laboratory, Charleston, SC. 98 pp.
8. Alderisio, K. A. and N. DeLuca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (Larus delawarensis) and Canada geese (Branta canadensis). Appl. Environ. Microbiol. 65:5628-5630.
9. TMDL report attributed to Metcalf and Eddy 1991 (Potomac Headwaters of West VA).

A.2 GIS Data Elements and Sources

Data Element	Source	Date
Watershed boundary	DEQ, USGS NLCD	2009, 2001
Land use	National Land Cover Data set (NLCD), US Geological Survey	2001
Elevation	Digital Elevation Models and Digital Raster Graphs, US Geological Survey	Various dates
Soils	SSURGO and STATSGO, National Resource Conservation Service	Various dates
Stream network	National Hydrography Dataset	1999
Stream flow data	Gauging stations, US Geological Survey	Various dates
Wastewater treatment plants	VA Department of Environmental Quality	Various dates
Dog population	US Census Bureau American Veterinary Association	2000
Domestic livestock	National Agricultural Statistics Service, USDA	2007
Wildlife	Virginia Department of Game and Inland Fisheries	2008, 2009
Septic tanks (from human population)	VA Department of Health US Census Bureau	Various dates 2000
Water quality monitoring stations	DEQ	Various dates
Water body volumes	Bathymetry collected by DEQ staff	Spring 2009
Tidal data	NOAA tide tables	2004

A3. GIS Data Description and Process

Watershed boundary determined by DEQ based upon USGS topographic maps.

The original land use has 15 categories that were combined into 3 categories:
urban (high and low density residential and commercial);
undeveloped (forest and wetlands); and
agriculture (pasture and crops).

Wastewater treatment plant locations as well as design flow, measured flow, overflows, and permitted bacteria discharge were obtained from DEQ.

Sewer failures were based upon the average failure rate and number of households within the Morris Creek watershed. Data provided by VDH confirmed that the estimated number of failures was accurate.

Wildlife includes ducks and geese, deer, muskrat, and raccoons. Animals were chosen based on availability of fecal coliform production rates and population estimates available by DGIF.

Human input was based on US Census Bureau population data (number of households) as well as a count of "homes" from aerial photography from 2002, multiplied by the average number of people per household from the US Census Bureau (2000).

Water quality monitoring data are collected, on average, once per month. The Digital data layer of locations was generated by DEQ. Water quality data was mathematically processed and input into a database.

Segment volume was determined from current field bathymetry data.

The 1998 303d report was used to set the list of impairments that require TMDLs.

A4. Population Numbers

The process used to generate population numbers used for the nonpoint source contribution analysis for the four source categories: human, livestock, pets and wildlife is described for each below.

Human:

The number of people contributing fecal coliform from failing septic tanks was determined from US Census Bureau data. Aerial photography suggested there were approximately 97 homes within the Morris Creek watershed. This number was multiplied by the US Census Bureau's (2000) average number of people per household (2.59) to get the total number of people estimated to be living in the watershed (251). The estimated Morris Creek human population was then multiplied by a septic failure rate* to get the number of people contributing fecal bacteria from failing septic tanks. This number was then divided by the number of people per household to obtain the estimated number of failing septic systems in Morris Creek watershed.

*The septic failure rate was estimated by dividing the number of deficiencies in the watershed by the total households in the watershed. The average septic failure rate was 12% and this was used as the default unless the local health department could indicate otherwise.

Livestock:

The United States Department of Agriculture (USDA) Census data (2007) was used to calculate the livestock estimates for cattle, chickens, and pigs in Morris Creek. The numbers for each type of livestock are reported by county. Given the area of Charles City Co (182.76 mi^2) and the area of the Morris Creek watershed (12.7mi^2), a number per unit area for each livestock type was calculated, see below.

Animal Type	Total Inventory Charles City Co	Animals/mi^2	Animals in Morris Cr Watershed
Cattle	260	1.4	18 (*rounded to **20***)
Pigs	7	0.038	0.486 (*rounded to **0***)
Chickens	280	1.532	19.45 *(rounded to **20**)*

Pets:

There are 2 ways in which pet (primarily dog) populations can be estimated. The first method uses a formula for estimating the number of pets using national percentages, reported by the American Veterinary Association: # dogs = # of households * 0.58. The result of this calculation is 97 * 0.58 = 56.26, or approximately 57 dogs.

Alternatively, the local county staff can be asked to derive an estimate of the dog population in a specific area. The Charles City County Animal Control staff supplied DEQ with a number of **425**, which includes the populations of nearby hunting kennels.

During the public meetings and in conversation amongst DEQ staff, it was agreed that the expertise of the local Animal Control staff was a more reliable estimate than the calculated number derived from

the American Veterinary Association's formula, therefore, 425 was used as the estimated dog population in Morris Creek watershed.

Cat numbers are not derived because the bacteria loading of cats is approximately 1/millionth the amount of that contributed by dogs and therefore is not considered significant.

Wildlife:

Deer

The number of deer was calculated using information supplied by DGIF, consisting of an average deer index by county and the formula:
#deer/mi^2 of deer habitat = (-0.64 + (7.74 * average deer index)). An average deer index of 35 deer/mi^2 was given to DEQ by DGIF for Charles City County. This number was multiplied by the square mileage for the Morris Creek watershed (35 * 12.7mi^2 = 444.5 deer) to arrive at the resultant estimate of approximately **450 deer**.

Ducks and Geese

A waterfowl density estimate was obtained for the Morris Creek watershed from DGIF. The density is based upon the spring Atlantic Flyway Northeast Plot Survey for 2008 (bird/km^2).
Total mileage for the watershed was converted to km and multiplied by each individual density given for black ducks, mallards, wood ducks, and Canadian geese as is shown below.

Bird Type	# Birds/km^2	Morris Creek watershed = 12.7mi^2 = 32.89km^2
Black Ducks	0	
Mallards	0.969	
Wood Ducks	0.563	
Total Ducks	1.532/km^2 * 32.89km^2 =	**50 ducks**
Canada Geese	1.969/km^2 *32.89km^2 =	**65 geese**

Raccoons

An estimate of the raccoon population was calculated using densities supplied by the Department of Game and Inland Fisheries (DGIF) (#raccoons/mi^2). Low density (10/mi^2) was described as upland forest and high density (50/mi^2) as bottomland forest, marsh, swamp, and wetlands—(including freshwater and saltwater, forested and herbaceous), and along streams. Given that within the watershed, all land use other than "wetland" is within 1 mile of some wetland or the creek itself, the high density value was used to calculate the estimated number of raccoons in Morris Creek, see below. For high density, DGIF suggested that agriculture land use (cropland and pasture) be left out of the equation (total agriculture = 2.6 mi^2; 12.7 – 2.6 = 10.1 mi^2)

50/mi^2 * 10.1mi^2 = 505 (rounded to **500 raccoons** in Morris Creek watershed)

Muskrats

Estimates for the muskrat population were supplied by DGIF (#muskrat/acre) for low (2/acre), average (10/acre freshwater and brackish marsh), and high (15/acre) densities. Wetland land-use equals 983 acres in the Morris Creek watershed. This number was multiplied by the average DGIF muskrat density, resulting in a total of 9830 and was rounded to **9800 muskrats** for the report.

Beaver

Estimates for beaver densities were supplied by DGIF (#beaver/mile) for low (1/mi), average (4.8/mi), and maximum densities (14.5/mi). Average density was multiplied by the total river miles of Morris Creek (13.4) to result in a total of 64.32, and rounded to **65 beavers**.

Appendix B: Water Quality Data Summary

B.1 Morris Creek Summary of Enterococci data at Station 2-MOC005.97

B.2 Morris Creek Summary of E. coli data at Station 2-MOC010.97

B.3 Morris Creek Graphic Summary of Enterococci data collected at Station 2-MOC005.97

B.4 Morris Creek Graphic Summary of *E. coli* data collected at Station 2-MOC010.97

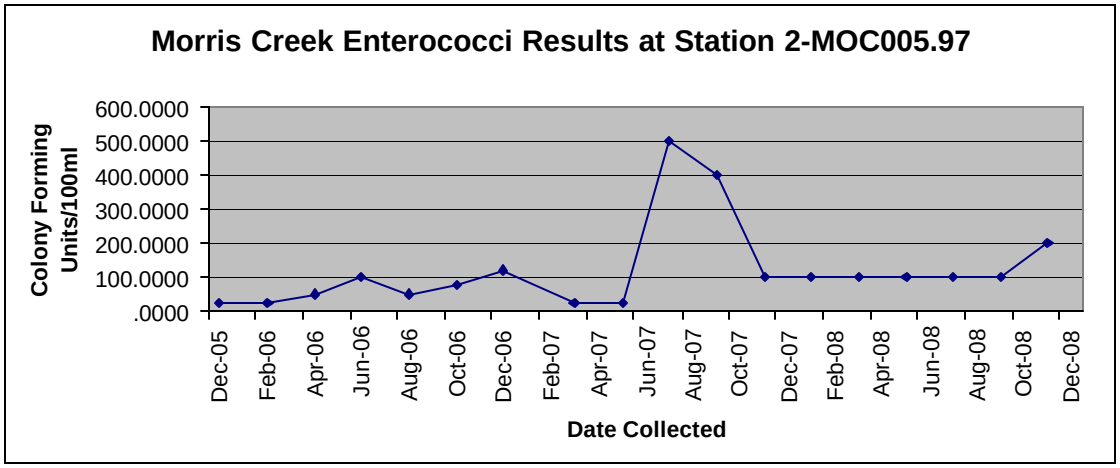
B.1 Morris Creek Summary of Enterococci data at Station 2-MOC005.97

Station 2-MOC005.97 Collection Date	Enterococci cfu/100ml	Exceeds Tidal Water Quality Standard of 104 cfu/100 ml
12/20/2005	25.0000	No
2/15/2006	25.0000	No
4/19/2006	50.0000	No
6/20/2006	100.0000	No
8/28/2006	50.0000	No
10/23/2006	75.0000	No
12/5/2006	120.0000	Yes
3/1/2007	25.0000	No
5/17/2007	25.0000	No
7/17/2007	500.0000	Yes
9/18/2007	400.0000	Yes
11/28/2007	100.0000	No
1/9/2008	100.0000	No
3/17/2008	100.0000	No
5/15/2008	100.0000	No
7/1/2008	100.0000	No
9/3/2008	100.0000	No
11/5/2008	200.0000	Yes

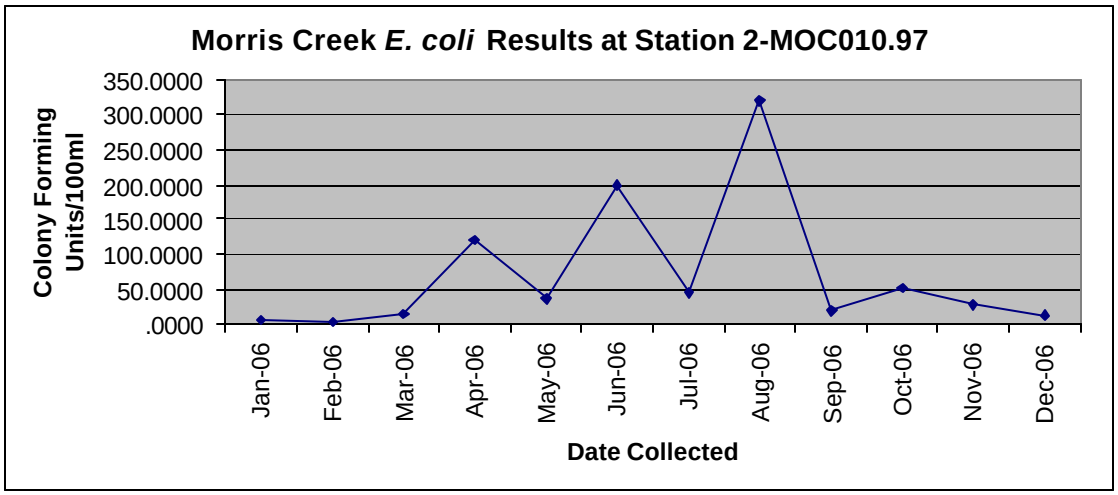
B.2 Morris Creek Summary of E. coli data at Station 2-MOC010.97

Station 2-MOC010.97 Collection Date	*E. coli* cfu/100ml	Exceeds Non-tidal WQS Standard 235 cfu/100ml
1/17/2006	7.0000	No
2/21/2006	5.0000	No
3/20/2006	15.0000	No
4/26/2006	120.0000	No
5/15/2006	37.0000	No
6/20/2006	200.0000	No
7/24/2006	45.0000	No
8/22/2006	320.0000	Yes
9/27/2006	20.0000	No
10/23/2006	53.0000	No
11/15/2006	28.0000	No
12/11/2006	13.0000	No

B.3 Morris Creek Graphic Summary of Enterococci data collected at Station 2-MOC005.97



B.4 Morris Creek Graphic Summary of *E. coli* data collected at Station 2-MOC010.97



Appendix C Applicable State Codes

C.1 Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.

C.2 Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000

C.1 Code of Virginia §62.1-194.1

§62.1-194.1. Obstructing or contaminating state waters.

Except as otherwise permitted by law, it shall be unlawful for any person to dump, place or put, or cause to be dumped, placed or put into, upon the banks of or into the channels of any state waters any object or substance, noxious or otherwise, which may reasonably be expected to endanger, obstruct, impede, contaminate or substantially impair the lawful use or enjoyment of such waters and their environs by others. Any person who violates any provision of this law shall be guilty of a misdemeanor and upon conviction be punished by a fine of not less than $100 nor more than $500 or by confinement in jail not more than twelve months or both such fine and imprisonment. Each day that any of said materials or substances so dumped, placed or put, or caused to be dumped, placed or put into, upon the banks of or into the channels of, said streams shall constitute a separate offense and be punished as such. In addition to the foregoing penalties for violation of this law, the judge of the circuit court of the county or corporation court of the city wherein any such violation occurs, whether there be a criminal conviction therefore or not shall, upon a bill in equity, filed by the attorney for the Commonwealth of such county or by any person whose property is damaged or whose property is threatened with damage from any such violation, award an injunction enjoining any violation of this law by any person found by the court in such suit to have violated this law or causing the same to be violated, when made a party defendant to such suit. (1968, c. 659.)

C.2 Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999
Revised as of July 1, 2000 From the U.S. Government Printing Office via GPO Access [CITE: 33CFR159]

NAVIGABLE WATERS
CHAPTER I--COAST GUARD, DEPARTMENT OF TRANSPORTATION (CONTINUED)
PART 159--MARINE SANITATION DEVICES

Subpart A--General

Sec.
159.1 Purpose.
159.3 Definitions.
159.4 Incorporation by reference.
159.5 Requirements for vessel manufacturers.
159.7 Requirements for vessel operators.

Subpart B--Certification Procedures

159.11 Purpose.
159.12 Regulations for certification of existing devices.
159.12a Certification of certain Type III devices.
159.14 Application for certification.
159.15 Certification.
159.16 Authorization to label devices.
159.17 Changes to certified devices.
159.19 Testing equivalency.

Subpart C--Design, Construction, and Testing

159.51 Purpose and scope.
159.53 General requirements.
159.55 Identification.
159.57 Installation, operation, and maintenance instructions.

Subpart D--Recognition of Facilities

Authority: Sec. 312(b)(1), 86 Stat. 871 (33 U.S.C. 1322(b)(1)); 49 CFR 1.45(b) and 1.46(l) and (m).

Source: CGD 73-83, 40 FR 4624, Jan. 30, 1975, unless otherwise noted.

Subpart A--General

Sec. 159.1 Purpose.

This part prescribes regulations governing the design and construction of marine sanitation devices and procedures for certifying that marine sanitation devices meet the regulations and the standards of the Environmental Protection Agency promulgated under section 312 of the Federal Water Pollution Control Act (33 U.S.C. 1322), to eliminate the discharge of untreated sewage from vessels into the waters of the United States, including the territorial seas. Subpart A of this part contains regulations governing the manufacture and operation of vessels equipped with marine sanitation devices.

Sec. 159.3 Definitions.

In this part:
Coast Guard means the Commandant or his authorized representative.
Discharge includes, but is not limited to, any spilling, leaking, pouring, pumping, emitting, emptying, or dumping.
Existing vessel includes any vessel, the construction of which was initiated before January 30, 1975.

Fecal coliform bacteria are those organisms associated with the intestine of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.
Inspected vessel means any vessel that is required to be inspected under 46 CFR Ch. I.
Length means a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments are not to be included in the measurement.
Manufacturer means any person engaged in manufacturing, assembling, or importing of marine sanitation devices or of vessels subject to the standards and regulations promulgated under section 312 of the Federal Water Pollution Control Act.
Marine sanitation device and device includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.
New vessel includes any vessel, the construction of which is initiated on or after January 30, 1975.
Person means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel.
Public vessel means a vessel owned or bare-boat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.
Recognized facility means any laboratory or facility listed by the Coast Guard as a recognized facility under this part.
Sewage means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body waste.
Territorial seas means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of 3 miles.
Type I marine sanitation device means a device that, under the test conditions described in Secs. 159.123 and 159.125, produces an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids.
Type II marine sanitation device means a device that, under the test conditions described in Secs. 159.126 and 159.126a, produces an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.
Type III marine sanitation device means a device that is designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage.
Uninspected vessel means any vessel that is not required to be inspected under 46 CFR Chapter I.
United States includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands.
Vessel includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the waters of the United States.

[CGD 96-026, 61 FR 33668, June 28, 1996, as amended by CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.4 Incorporation by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in paragraph (b) of this section, the Coast Guard must publish notice of change in the Federal Register; and the material must be available to the public. All approved material is available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC, and at the U.S. Coast Guard Office of Design and Engineering Standards (G-MSE), 2100 Second Street SW., Washington, DC 20593-0001, and is available from the sources indicated in paragraph (b) of this section.
(b) The material approved for incorporation by reference in this part, and the sections affected, are as follows:

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 11-95, Standard Specification for Wire Cloth and Sieves for Testing Purposes--159.125

[USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.5 Requirements for vessel manufacturers.

No manufacturer may manufacture for sale, sell, offer for sale, or distribute for sale or resale any vessel equipped with installed toilet facilities unless it is equipped with:

(a) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(b) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

[CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.7 Requirements for vessel operators.

(a) No person may operate any vessel equipped with installed toilet facilities unless it is equipped with:

(1) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(2) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

(b) When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3 or 140.4, the operator must secure each Type I or Type II device in a manner which prevents discharge of treated or untreated sewage. Acceptable methods of securing the device include--

(1) Closing the seacock and removing the handle;

(2) Padlocking the seacock in the closed position;

(3) Using a non-releasable wire-tie to hold the seacock in the closed position; or

(4) Locking the door to the space enclosing the toilets with a padlock or door handle key lock.

(c) When operating a vessel on a body of water where the discharge of untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3, the operator must secure each Type III device in a manner which prevents discharge of sewage. Acceptable methods of securing the device include--

(1) Closing each valve leading to an overboard discharge and removing the handle;

(2) Padlocking each valve leading to an overboard discharge in the closed position; or

(3) Using a non-releasable wire-tie to hold each valve leading to an overboard discharge in the closed position.

[CGH 95-028, 62 FR 51194, Sept. 30, 1997]

Subpart B--Certification Procedures

Sec. 159.11 Purpose.

This subpart prescribes procedures for certification of marine sanitation devices and authorization for labels on certified devices.

Sec. 159.12 Regulations for certification of existing devices.

(a) The purpose of this section is to provide regulations for certification of existing devices until manufacturers can design and manufacture devices that comply with this part and recognized facilities are prepared to perform the testing required by this part.

(b) Any Type III device that was installed on an existing vessel before January 30, 1975, is considered certified.

(c) Any person may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 for certification of a marine sanitation device manufactured before January 30, 1976. The Coast Guard will issue a letter certifying the device if the applicant shows that the device meets Sec. 159.53 by:

(1) Evidence that the device meets State standards at least equal to the standards in Sec. 159.53, or

(2) Test conducted under this part by a recognized laboratory, or

(3) Evidence that the device is substantially equivalent to a device certified under this section, or

(4) A Coast Guard field test if considered necessary by the Coast Guard.

(d) The Coast Guard will maintain and make available a list that identifies each device certified under this section.

(e) Devices certified under this section in compliance with Sec. 159.53 need not meet the other regulations in this part and may not be labeled under Sec. 159.16.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.12a Certification of certain Type III devices.

(a) The purpose of this section is to provide regulations for certification of certain Type III devices.

(b) Any Type III device is considered certified under this section if:

(1) It is used solely for the storage of sewage and flushwater at ambient air pressure and temperature; and

(2) It is in compliance with Sec. 159.53(c).

(c) Any device certified under this section need not comply with the other regulations in this part except as required in paragraphs (b)(2)and (d) of this section and may not be labeled under Sec. 159.16.

d) Each device certified under this section which is installed aboard an inspected vessel must comply with Sec. 159.97.

[CGD 76-145, 42 FR 11, Jan. 3, 1977]

Sec. 159.14 Application for certification.

(a) Any manufacturer may apply to any recognized facility for certification of a marine sanitation device. The application for certification must indicate whether the device will be used aboard all vessels or only aboard uninspected vessels and to which standard in Sec. 159.53 the manufacturer requests the device to be tested.

(b) An application may be in any format but must be in writing and must be signed by an authorized representative of the manufacturer and include or be accompanied by:

(1) A complete description of the manufacturer's production quality control and inspection methods, record keeping systems pertaining to the manufacture of marine sanitation devices, and testing procedures;

(2) The design for the device, including drawings, specifications and other information that describes the materials, construction and operation of the device;

(3) The installation, operation, and maintenance instructions for the device; and

(4) The name and address of the applicant and the manufacturing facility.

(c) The manufacturer must furnish the recognized facility one device of each model for which certification is requested and samples of each material from which the device is constructed, that must be tested destructively under Sec. 159.117. The device furnished is for the testing required by this part except that, for devices that are not suited for unit testing, the manufacturer may submit the design so that the recognized facility may determine the components of the device and materials to be submitted for testing and the tests to be performed at a place other than the facility. The Coast Guard must review and accept all such determinations before testing is begun.

(d) At the time of submittal of an application to a recognized facility the manufacturer must notify the Coast Guard of the type and model of the device, the name of the recognized facility to which application is being made, and the name and address of the manufacturer, and submit a signed statement of the times when the manufacturer will permit designated officers and employees of the Coast Guard to have access to the manufacturer's facilities and all records required by this part.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.15 Certification.

(a) The recognized facility must evaluate the information that is submitted by the manufacturer in accordance with Sec. 159.14(b) (1), (2), and (3), evaluate the device for compliance with Secs. 159.53 through 159.95, test the device in accordance with Sec. 159.101 and submit to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 the following:

(1) The information that is required under Sec. 159.14(b);

(2) A report on compliance evaluation;

(3) A description of each test;

(4) Test results; and

(5) A statement, that is signed by the person in charge of testing, that the test results are accurate and complete.

(b) The Coast Guard certifies a test device, on the design of the device, if it determines, after consideration of the information that is required under paragraph (a) of this section, that the device meets the requirements in Subpart C of this part.

(c) The Coast Guard notifies the manufacturer and recognized facility of its determination under paragraph (b) of this section. If the device is certified, the Coast Guard includes a certification number for the device. If certification is denied, the Coast Guard notifies the manufacturer and recognized facility of the requirements of this part that are not met. The manufacturer may appeal a denial to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

(d) If upon re-examination of the test device, the Coast Guard determines that the device does not in fact comply with the requirements of Subpart C of this part, it may terminate the certification.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.16 Authorization to label devices.

(a) When a test device is certified under Sec. 159.15(b), the Coast Guard will issue a letter that authorizes the manufacturer to label each device that he manufactures with the manufacturer's certification that the device is in all material respects substantially the same as a test device certified by the U.S. Coast Guard pursuant to section 312 of the Federal Water Pollution Control Act Amendments of 1972.

(b) Certification placed on a device by its manufacturer under this section is the certification required by section 312(h)(4) of the Federal Water Pollution Control Act Amendments of 1972, which makes it unlawful for a vessel that is subject to the standards and regulations promulgated under the Act to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to section 312 of the Act.

(c) Letters of authorization issued under this section are valid for 5 years, unless sooner suspended, withdrawn, or terminated and may be reissued upon written request of the manufacturer to whom the letter was issued.

(d) The Coast Guard, in accordance with the procedure in 46 CFR 2.75, may suspend, withdraw, or terminate any letter of authorization issued under this section if the Coast Guard finds that the manufacturer is engaged in the manufacture of devices labeled under this part that are not in all material respects substantially the same as a test device certified pursuant to this part.

Sec. 159.17 Changes to certified devices.

(a) The manufacturer of a device that is certified under this part shall notify the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 in writing of any change in the design of the device.

(b) A manufacturer shall include with a notice under paragraph (a) of this section a description of the change, its advantages, and the recommendation of the recognized facility as to whether the device remains in all material respects substantially the same as the original test device.

(c) After notice under paragraph (a) of this section, the Coast Guard notifies the manufacturer and the recognized facility in writing of any tests that must be made for certification of the device or for any change in the letter of authorization. The manufacturer may appeal this determination to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.19 Testing equivalency.

(a) If a test required by this part may not be practicable or necessary, a manufacturer may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, DC 20593-0001 for deletion or approval of an alternative test as equivalent to the test requirements in this part. The application must include the manufacturer's justification for deletion or the alternative test and any alternative test data.

(b) The Coast Guard notifies the manufacturer of its determination under paragraph (a) of this section and that determination is final.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Subpart C--Design, Construction, and Testing

Sec. 159.51 Purpose and scope.

(a) This subpart prescribes regulations governing the design and construction of marine sanitation devices.

(b) Unless otherwise authorized by the Coast Guard each device for which certification under this part is requested must meet the requirements of this subpart.

Sec. 159.53 General requirements.

A device must:

(a) Under the test conditions described in Secs. 159.123 and 159.125, produce an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids (Type I),

(b) Under the test conditions described in Secs. 159.126 and 159.126a, produce an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter (Type II), or

(c) Be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage (Type III).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.55 Identification.

(a) Each production device must be legibly marked in accordance with paragraph (b) of this section with the following information:

(1) The name of the manufacturer.

(2) The name and model number of the device.

(3) The month and year of completion of manufacture.

(4) Serial number.

(5) Whether the device is certified for use on an inspected or an uninspected vessel.

(6) Whether the device is Type I, II, or III.

(b) The information required by paragraph (a) of this section must appear on a nameplate attached to the device or in lettering on the device. The nameplate or lettering stamped on the device must be capable of withstanding without loss of legibility the combined effects of normal wear and tear and exposure to water, salt spray, direct sunlight, heat, cold, and any substance listed in Sec. 159.117(b) and (c). The nameplate and lettering must be designed to resist efforts to remove them from the device or efforts to alter the information stamped on the nameplate or the device without leaving some obvious evidence of the attempted removal or alteration.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.57 Installation, operation, and maintenance instructions.

(a) The instructions supplied by the manufacturer must contain directions for each of the following:

(1) Installation of the device in a manner that will permit ready access to all parts of the device requiring routine service and that will provide any flue clearance necessary for fire safety.

(2) Safe operation and servicing of the device so that any discharge meets the applicable requirements of Sec. 159.53.

(3) Cleaning, winter layup, and ash or sludge removal.

(4) Installation of a vent or flue pipe.

(5) The type and quantity of chemicals that are required to operate the device, including instructions on the proper handling, storage and use of these chemicals.

(6) Recommended methods of making required plumbing and electrical connections including fuel connections and supply circuit overcurrent protection.

(b) The instructions supplied by the manufacturer must include the following information:

(1) The name of the manufacturer.

(2) The name and model number of the device.

(3) Whether the device is certified for use on an inspected, or uninspected vessel.

(4) A complete parts list.

(5) A schematic diagram showing the relative location of each part.

(6) A wiring diagram.

(7) A description of the service that may be performed by the user without coming into contact with sewage or chemicals.

(8) Average and peak capacity of the device for the flow rate, volume, or number of persons that the device is capable of serving and the period of time the device is rated to operate at peak capacity.

(9) The power requirements, including voltage and current.
(10) The type and quantity of fuel required.
(11) The duration of the operating cycle for unitized incinerating devices.
(12) The maximum angles of pitch and roll at which the device operates in accordance with the applicable requirements of Sec. 159.53.
(13) Whether the device is designed to operate in salt, fresh, or brackish water.
(14) The maximum hydrostatic pressure at which a pressurized sewage retention tank meets the requirements of Sec. 159.111.
(15) The maximum operating level of liquid retention components.
(16) Whether the device is Type I, II, or III.
(17) A statement as follows:
Note: The EPA standards state that in freshwater lakes, freshwater reservoirs or other freshwater impoundments whose inlets or outlets are such as to prevent the ingress or egress by vessel traffic subject to this regulation, or in rivers not capable of navigation by interstate vessel traffic subject to this regulation, marine sanitation devices certified by the U.S. Coast Guard installed on all vessels shall be designed and operated to prevent the overboard discharge of sewage, treated or untreated, or of any waste derived from sewage. The EPA standards further state that this shall not be construed to prohibit the carriage of Coast Guard-certified flow-through treatment devices which have been secured so as to prevent such discharges. They also state that waters where a Coast Guard-certified marine sanitation device permitting discharge is allowed include coastal waters and estuaries, the Great Lakes and interconnected waterways, freshwater lakes and impoundments accessible through locks, and other flowing waters that are navigable interstate by vessels subject to this regulation (40 CFR 140.3).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.59 Placard.

Each device must have a placard suitable for posting on which is printed the operating instructions, safety precautions, and warnings pertinent to the device. The size of the letters printed on the placard must be one-eighth of an inch or larger.

Sec. 159.61 Vents.

Vents must be designed and constructed to minimize clogging by either the contents of the tank or climatic conditions such as snow or ice.

Sec. 159.63 Access to parts.
Each part of the device that is required by the manufacturer's instructions to be serviced routinely must be readily accessible in the installed position of the device recommended by the manufacturer.

Sec. 159.65 Chemical level indicator.

The device must be equipped with one of the following:
(a) A means of indicating the amount in the device of any chemical that is necessary for its effective operation.
(b) A means of indicating when chemicals must be added for the proper continued operation of the device.

Sec. 159.67 Electrical component ratings.

Electrical components must have current and voltage ratings equal to or greater than the maximum load they may carry.

Sec. 159.69 Motor ratings.

Motors must be rated to operate at 50 deg.C ambient temperature.

Sec. 159.71 Electrical controls and conductors.

Electrical controls and conductors must be installed in accordance with good marine practice. Wire must be copper and must be stranded. Electrical controls and conductors must be protected from exposure to chemicals and sewage.

Sec. 159.73 Conductors.

Current carrying conductors must be electrically insulated from non-current carrying metal parts.

Sec. 159.75 Overcurrent protection.

Overcurrent protection must be provided within the unit to protect subcomponents of the device if the manufacturer's recommended supply circuit overcurrent protection is not adequate for these subcomponents.

Sec. 159.79 Terminals.

Terminals must be solderless lugs with ring type or captive spade ends, must have provisions for being locked against movement from vibration, and must be marked for identification on the wiring diagram required in Sec. 159.57. Terminal blocks must be nonabsorbent and securely mounted. Terminal blocks must be provided with barrier insulation that prevents contact between adjacent terminals or metal surfaces.

Sec. 159.81 Baffles.

Baffles in sewage retention tanks, if any, must have openings to allow liquid and vapor to flow freely across the top and bottom of the tank.

Sec. 159.83 Level indicator.

Each sewage retention device must have a means of indicating when the device is more than \3/4\ full by volume.

Sec. 159.85 Sewage removal.

The device must be designed for efficient removal of nearly all of the liquid and solids in the sewage retention tank.

Sec. 159.87 Removal fittings.

If sewage removal fittings or adapters are provided with the device, they must be of either 1\1/2\" or 4" nominal pipe size.

Sec. 159.89 Power interruption: Type I and II devices.

A discharge device must be designed so that a momentary loss of power during operation of the device does not allow a discharge that does not meet the requirements in Sec. 159.53.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.93 Independent supporting.

The device must have provisions for supporting that are independent from connecting pipes.

Sec. 159.95 Safety.

(a) Each device must--
(1) Be free of design defects such as rough or sharp edges that may cause bodily injuries or that would allow toxic substances to escape to the interior of the vessel;
(2) Be vented or provided with a means to prevent an explosion or over pressurization as a result of an accumulation of gases; and
(3) Meet all other safety requirements of the regulations applicable to the type of vessel for which it is certified.
(b) A chemical that is specified or provided by the manufacturer for use in the operation of a device and is defined as a hazardous material in 46 CFR Part 146 must be certified by the procedures in 46 CFR Part 147.

(c) Current carrying components must be protected from accidental contact by personnel operating or routinely servicing the device. All current carrying components must as a minimum be of drip-proof construction or be enclosed within a drip-proof compartment.

Sec. 159.97 Safety: inspected vessels.

The Commandant approves the design and construction of devices to be certified for installation and operation on board inspected vessels on the basis of tests and reports of inspection under the applicable marine engineering requirements in Subchapter F of Title 46, Code of Federal Regulations, and under the applicable electrical engineering requirements in Subchapter J of Title 46 Code of Federal Regulations.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.101 Testing: general.

Unless otherwise authorized by the Coast Guard, a recognized facility must perform each test described in Secs. 159.103 through 159.131. The same device must be used for each test and tested in the order in which the tests are described. There must be no cracking, softening, deterioration, displacement, breakage, leakage or damage of components or materials that affects the operation or safety of the device after each test described in Secs. 159.103 through 159.117 and Sec. 159.121, and the device must remain operable after the test described in Sec. 159.119. The device must be set up in a manner simulating installation on a vessel in accordance with the manufacturer's instructions with respect to mounting, water supply, and discharge fittings.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.103 Vibration test.

The device, with liquid retention components, if any, filled with water to one-half of their volume, must be subjected to a sinusoidal vibration for a period of 12 hours, 4 hours in each of the x, y, and z planes, at the resonant frequency of the device (or at 55 cycles per second if there is no resonant frequency between 10 to 60 hertz) and with a peak amplitude of 0.019 to 0.021 inches.

Sec. 159.105 Shock test.

The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 1,000 vertical shocks that are ten times the force of gravity (10g) and have a duration of 20-25 milliseconds measured at the base of the half-sine shock envelope.

Sec. 159.107 Rolling test.

(a) The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 100 cycles with the axis of rotation 4 feet from the centerline of the device, no more than 6 inches below the plane of the bottom of the device, and parallel to any tank baffles. The device must then be rotated 90 degrees on its vertical axis and subjected to another 100 cycles. This testing must be repeated with the liquid retention components filled to the maximum operating level as specified by the manufacturer in Sec. 159.57.

(b) Eighty percent of the rolling action must be approximately 15 degrees on either side of the vertical and at a cyclic rate of 3 to 4 seconds. Twenty percent motions must be approximately 30 degrees, or the maximum angle specified by the manufacturer under Sec. 159.57, whichever is greater, on either side of the vertical at a cyclic rate of 6 to 8 seconds.

Sec. 159.109 Pressure test.

Any sewage retention tank that is designed to operate under pressure must be pressurized hydrostatically at a pressure head of 7 feet or to 150 percent of the maximum pressure specified by the manufacturer for operation of the tank, whichever is greater. The tank must hold the water at this pressure for 1 hour with no evidence of leaking.

Sec. 159.111 Pressure and vacuum pulse test.

Liquid retention components of the device with manufacturer specified venting installed must be subjected to 50 fillings of water at a pressure head of 7 feet or the maximum pressure specified by the manufacturer for operation of the device, whichever is greater, and then emptied with a 45 gallon per minute or larger positive displacement pump that remains in operation 30 seconds after emptying the tank at the end of each cycle.

Sec. 159.115 Temperature range test.

(a) The device must be held at a temperature of 60 deg.C or higher for a period of 16 hours.
(b) The device must be held at a temperature of -40 deg.C or less for a period of 16 hours following winterization in accordance with manufacturers' instructions.

Sec. 159.117 Chemical resistance test.

(a) In each case where the recognized facility doubts the ability of a material to withstand exposure to the substances listed in paragraphs (b) and (c) of this section a sample of the material must be tested.
(b) A sample referred to in paragraph (a) of this section must be partially submerged in each of the following substances for 100 hours at an ambient temperature of 22 deg.C.
(1) Sewage.
(2) Any disinfectant that is required in the operation of the device.
(3) Any chemical compound in solid, liquid or gaseous form, used, emitted or produced in the operation of the device.
(4) Fresh or salt (3.5 percent Sodium Chloride) flush water.
(5) Toilet bowl cleaners.
(6) Engine Oil (SAE/30).
(7) Ethylene Glycol.
(8) Detergents (household and bilge cleaning type).
(c) A sample of the material must be doused 20 times, with a 1 hour drying period between dousings, in each of the following substances:
(1) Gasoline.
(2) Diesel fuel.
(3) Mineral spirits.
(4) Turpentine.
(5) Methyl alcohol.

Sec. 159.119 Operability test; temperature range.

The device must operate in an ambient temperature of 5 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C and in an ambient temperature of 50 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C.

Sec. 159.121 Sewage processing test.

(a) The device must process human sewage in the manner for which it is designed when tested in accordance with this section. There must be no sewage or sewage-treating chemicals remaining on surfaces or in crevices that could come in contact with a person using the device or servicing the device in accordance with the instructions supplied under Sec. 159.57(b)(7).
(b) During the test the device must be operated and maintained in accordance with the manufacturer's instructions. Any initial start-up time specified by the manufacturer must be allowed before test periods begin. For 1 hour of each 8-hour test period, the device must be tilted to the maximum angles specified by the manufacturer under Secs. 159.55 and 159.57.
(c) Except for devices described in paragraph (d) of this section, the devices must process and discharge or store human sewage over at least an 8-consecutive hour period on at least 10 days within a 20-day period. The device must receive human sewage consisting of fecal matter, urine, and toilet paper in a ratio of four urinations to one defecation with at least one defecation per person per day. Devices must be tested at their average rate of capacity as specified in Sec. 159.57. In addition, during three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity.

(d) A device that processes and discharges continuously between individual use periods or a large device, as determined by the Coast Guard, must process and discharge sewage over at least 10-consecutive days at the average daily capacity specified by the manufacturer. During three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity. The sewage for this test must be fresh, domestic sewage to which primary sludge has been added, as necessary, to create a test sewage with a minimum of 500 milligrams of suspended solids per liter.

Sec. 159.123 Coliform test: Type I devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent discharged from a Type I device during the test described in Sec. 159.121 must be less than 1000 per 100 milliliters when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10-test days, one sample must be taken at the beginning, middle, and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.125 Visible floating solids: Type I devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples of approximately 1 liter each shall be taken from a Type I device at the same time as samples taken in Sec. 159.123 and passed expeditiously through a U.S. Sieve No. 12 as specified in ASTM E 11 (incorporated by reference, see Sec. 159.4). The weight of the material retained on the screen after it has been dried to a constant weight in an oven at 103 deg.C. must be divided by the volume of the sample and expressed as milligrams per liter. This value must be 10 percent or less of the total suspended solids as determined in accordance with 40 CFR Part 136 or at least 38 of the 40 samples.

Note: 33 U.S.C. 1321(b)(3) prohibits discharge of harmful quantities of oil into or upon the navigable waters of the United States or adjoining shorelines or into or upon the waters of the contiguous zone. Under 40 CFR 110.3 and 110.4 such discharges of oil include discharges which:

(a) Violate applicable water quality standards, or

(b) Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If a sample contains a quantity of oil determined to be harmful, the Coast Guard will not certify the device.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.126 Coliform test: Type II devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent from a Type II device during the test described in Sec. 159.121 must be 200 per 100 milliliters or less when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10 test days, one sample must be taken at the beginning, middle and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.126a Suspended solids test: Type II devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples must be taken at the same time as samples are taken for Sec. 159.126 and they must be analyzed for total suspended solids in accordance with 40 CFR Part 136. The arithmetic mean of the total suspended solids in 38 of 40 of these samples must be less than or equal to 150 milligrams per liter.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.127 Safety coliform count: Recirculating devices.

Thirty-eight of forty samples of flush fluid from a re-circulating device must have less than 240 fecal coliform bacteria per 100 milliliters. These samples must be collected in accordance with Sec. 159.123(b) and tested in accordance with 40 CFR Part 136.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.129 Safety: Ignition prevention test.

(a) Components of a device that are a potential ignition source in an explosive atmosphere must pass the test in paragraph (b) or (c) of this section or meet the requirements of paragraph (d) or have a specific warning in the instruction manual required by Sec. 159.57 that the device should not be installed in an explosive atmosphere.

(b) Components protected by vapor exclusion must be placed in a chamber filled with a rich mixture of gasoline or propane in air with the pressure being varied from 0 to 2 psig once an hour for 8 hours. Vapor readings must be taken in the void being protected and must indicate a leakage less than 20 percent of the lower explosive limit of the mixture in the chamber.

(c) Components providing ignition protection by means other than vapor exclusion must be fitted with an ignition source, such as a spark plug, and a means of injecting an explosive mixture of gasoline or propane and air into the void that protects the component. Connections must be made so as to minimize any additional volume added to the protected void by the apparatus delivering the explosive mixture. The component must be placed in a chamber filled with an explosive mixture and there must be no ignition of the explosive mixture surrounding the component when the following tests are conducted:

(1) Using any overload protection that is part of the device, the potential ignition source must be operated for one half hour at 110 percent of its rated voltage, one half hour at 50 percent of its rated voltage and one half hour at 100 percent of its rated voltage with the motor or armature locked, if the potential ignition source is a motor or part of a motor's electrical circuit.

(2) With the explosive mixture in the protected void, the test installed ignition source must be activated 50 times.

(3) The tests paragraphs (c) (1) and (2) of this section must be repeated with any plugs removed.

(d) Components that are certified as being intrinsically safe in accordance with the Instrument Society of America (RP 12.2) or explosion proof in accordance with the Underwriters Laboratories STD 698 in Class I, Group D hazardous locations (46 CFR 111.80-5(a)) need not be subjected to this testing.

Sec. 159.131 Safety: Incinerating device.

An incinerating device must not incinerate unless the combustion chamber is closed, must purge the combustion chamber of combustible fuel vapors before and after incineration must secure automatically if the burner does not ignite, must not allow an accumulation of fuel, and must neither produce a temperature on surfaces adjacent to the incineration chamber higher than 67 deg.C nor produce a temperature on surfaces in normal body contact higher than 41 deg.C when operating in an ambient temperature of 25 deg.C. Unitized incineration devices must completely burn to a dry, inert ash, a simultaneous defecation and urination and must not discharge fly ash, malodors, or toxic substances.

Subpart D--Recognition of Facilities

Sec. 159.201 Recognition of facilities.

A recognized facility is an independent laboratory accepted by the Coast Guard under 46 CFR 159.010 to perform the tests and inspections required under this part. A list of accepted laboratories is available from the Commandant (G-MSE-3).

[CGD 95-028, 62 FR 51194, Sept. 30, 1997, as amended by USCG-1999-5832, 64 FR 34715, June 29, 1999]

Appendix D: Public Comments